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AN ADVANCEMENT IN WOUND HEALING - STANDARD VAC SIMPLIFIED REDUCING ECONOMIC BURDEN IN PATIENTS WITH CHRONIC WOUNDS.

KEYWORDS: Simplified NPWT- Simplified Negative pressure wound therapy.

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ABSTRACT

Introduction: Delayed wound healing is a significant health problem and in addition to pain, poses a significant challenge in view of social and financial burdens. The objective of this study was to determine whether Negative pressure wound therapy (NPWT) would afford a quicker wound resolution in comparison to the conventional normal saline dressings in treatment of post-operative wounds.

AIM : To determine the efficacy of simplified Vac and its cost benefit analysis by comparing it with normal saline soaked conventional gauze dressings.

Material and Methods: 30 patients were selected. After thorough debridement, simplified Vac was applied in 15 patients and changed for every 5 days upto 20 days (4 sessions). Saline soaked guaze dressings were advised in remaining 15 patients and changed twice daily upto 20 days.

Results: 33.3% cost reduction and 73.33% patients achieving more than 70% granulation in 20 days with 94.1%patient compliance was observed in vac group when compared to conventional dressing.

Conclusions: Use of simplified Vac in our study led to early satisfactory results, decreased hospital stay, increased compliance to therapy in a cost effective way.

Introduction

In 1993, Fleischmann et al., first documented the use of sub-atmospheric pressure to manage chronic wounds.[1] Argenta expanded this method by publishing a clinical report on effect of NPWT on complicated wounds.[2] Vac technique entails placing an open cell foam into the wound, sealing the site with an adhesive drape & applying sub-atmospheric pressure (125 mm Hg below ambient) that is transmitted to the wound in a controlled manner.[3,4] It works on the principle of application of micromechanical forces that promote wound healing.[5,6] Vac works by both macrostrain & microstrain. Macrostrain causes foam to contract under controlled negative pressure, drawing the wound edges together reducing the overall wound area and allowing granulation tissue to fill in.[7,8] Microstrain is the transduction of pressure to tissue surfaces, resulting in cell surface deformation. As the tissue surface is being pulled up into the pores (tissue stretch), cells that are allowed to stretch tend to divide & proliferate in the presence of soluble mitogens where as retracted cell remain quiescent.[7,9]

This system eliminates interstitial oedema, exudates & debrides while increasing the perfusion leading to a more rapid promotion of wound healing with less bacterial loading & high rate of granulation tissue growth.[7,10,11,25]

Topical negative pressure wound therapy is believed to hasten the wound healing by a)Increasing the rate of growth of granulation tissue, b)Stimulating proliferation of capillaries (angiogenesis), c)Increasing local blood flow, d)Applying mechanical pressure to promote wound closure. e)Reducing bacterial load in the wound, f)Suctioning matrix metallo-protease in wound credentials, g)Maintains a moist micro environment, beneficial for wound closure.[7,9,10,11]

Indications:

NPWT is known to accelerate healing not only in acute traumatic wounds but also in chronic non-healing wounds, pressure ulcers, post-operative sternal infections, necrotising fasciitis, fasciotomy defects, contaminated wounds, burns, diabetic ulcers, gunshot wounds, pilonidal sinus, abdominal peritoneal resections & pelvic exenterations.[15-21]

Smith et al., in a retrospective review, described the use of vacuum pack technique as a treatment method of choice for open abdomen management and temporary abdomen closure.[22] Recent advances have been made successful with use of Vac therapies in complicated head and neck wounds, reconstructive procedures,[17] Studies have been noted, with regard to use of Vac to treat wounds of maxillo fascial region, mandibular plate exposition and necrotising cervicofascial fasciitis.[12,13,14]

Contraindications of Vac

The limitation of Vac includes malignant ulcers, osteomyelitis, wounds with ischemic tissue, wound overlying any blood vessel.

Complications of Vac

Most common complications include pain associated with removal of foam dressing and from collapse and adhesion of foam to wound bed, bleeding on removal of foam attached to wound bed. Other less common complications include excessive tissue growth into the dressing (hypergranulation). Maceration & dermatitis has been cited as rare complications.

AIM : To determine the efficacy of simplified Vac and its cost benefit analysis by comparing it with normal saline soaked conventional gauze dressings.

Materials & Methods: Out of 50 patients presenting with ulcer over a period of 6 months, 30 patients were selected. Among the patients selected 18 were diabetics , they were distributed equally in both the groups.

Criteria of exclusion: Patients with recognised charcot's disease, ulcers from electrical, chemical, radiation burns & those with malignancy, untreated osteomyelitis were excluded.

In experimental group after surgical debridement, simplified Vac was applied and changed for every 5 days upto 20 days (4 sessions).

In control group, Saline soaked guaze dressings were applied at the time of surgical debridement and changed twice daily upto

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

20 days.

Method: The dressing consists of normal polyurethane (PU) duster sponge (Fig 1) that is cut to fit the wound cavity exactly. A hole is tunnelled in the sponge for the placement of chest drain 32 French (Fig 2). The sponge is covered with an adhesive drape 3M™ Ioban™ 2 Antimicrobial Incise Drape 6640 (Fig 2) which creates a sealed environment. The adhesive drape is placed over the foam extending to a minimum of 3 cm over the normal skin. This is in turn connected to the negative pressure generator - ward suction machine (Fig 3) which is the source for suction and drainage. The negative pressure genera or maintains the pressure at 125mmHg sub atmospheric level. The negative pressure is applied intermittently manually (thirty minutes on and thirty min off) (Fig 4). Measurements & Photographs were taken to document wound progress in both the groups.

Fig 1 : Normal duster sponge

Fig 2: Chest drain 32 French and Ioban sheet

Fig 3: Ward suction machine

Fig 4: Simplified vac in situ

Outcomes are measured by

- Time taken for satisfactory healing (calculated from the date of initial debridement to date of definitive closure with granulation >80% of wound area. Satisfactory healing in the Vac group was achieved in 73.33%compared to 49.42% in control group within 20 days.

1.Age distribution: The mean age of the subjects in the conventional dressing group is 55.33 ± 4.83. The mean age of the subjects in the simplified Vac group is 56.93 ± 5.06.

2. Sex distribution: The sex distribution of the conventional dressing group is: 60% males (9 patients) and 40% females (6 patients). The sex distribution of the Simplified Vac group is: 60% males (9 patients) and 40% females (6 patients).

3. Infective burden: Swabs were taken from all wounds and sent for culture and sensitivity. In 83.33 % of wounds, pathogenic organism was cultured and in 16.7% wounds culture was sterile. The most commonly isolated organism was Staphylococcus aureus, followed by Klebsiella and Pseudomonas.

4. Area of wound: All the wounds were traced with the help of appropriately cut sterile gauze onto a graph paper and area was determined by counting the squares. The mean area of the wound in square centimetres (sq.cm) is 50.56 ± 6.94 in the conventional group. The minimum area was 38.70 sq.cm and the maximum area was 60.34 sq.cm in the conventional group.

The mean area of the wound in square centimetres (sq.cm) is 52.23 ± 5.12 in the VAC group. The minimum area was 42.86 sq.cm and the maximum area was 60.24 sq.cm in the VAC group.

5. Rate of granulation

Rate of granulation: Assessment at day 0
The mean percentages of granulation over the ulcer floor in conventional and VAC groups are 4.47 ± 2.62 and 4.67 ± 3.53 respectively.

The frequencies in both groups against the various percentages of granulation are tabulated in Table 1.

Rate of granulation: Assessment at day 5
The mean percentages of granulation at day 6 over the ulcer floor in conventional and VAC groups are 13.48 ± 7.42 and 20.74 ± 9.40 respectively.

The frequencies in both groups against the various percentages of granulation are tabulated in Table 1.

Rate of granulation: Assessment at day 10
The mean percentages of granulation at day 6 over the ulcer floor in conventional and VAC groups are 25.87 ± 8.16 and 34.88 ± 10.72 respectively.

The frequencies in both groups against the various percentages of granulation are tabulated in Table 1.

Rate of granulation: Assessment at day 15
The mean percentages of granulation at day 6 over the ulcer floor in conventional and VAC groups are 38.91 ± 7.94 and 52.33 ± 9.43 respectively.

The frequencies in both groups against the various percentages of granulation are tabulated in Table 1.

Rate of granulation: Assessment at day 20
The mean percentages of granulation at day 6 over the ulcer floor in conventional and VAC groups are 49.42 ± 10.79 and 71.6 ± 8.37 respectively.

The frequencies in both groups against the various percentages of granulation are tabulated in Table 1.

Table 1: The frequencies in both groups against the various percentages of granulation

	Day0	Day0	Day 5	Day5	Day10	Day 10	Day 15	Day 15	Day 20	Day 20
Percentage granulation	Con	Vac	Con	Vac	Con	Vac	Con	Vac	Con	Vac
<5%	11	11	-	-	-	-	-	-	-	-
5-10%	3	2	8	3	-	-	-	-	-	-
10-20%	1	2	4	7	4	-	-	-	-	-
20-30%	-	-	2	3	6	9	1	-	-	-
30-40%	-	-	1	2	4	2	7	2	-	-
40-50%	-	-	-	-	1	2	6	3	3	-
50-60%	-	-	-	-	-	2	1	8	5	1
60-70%	-	-	-	-	-	-	-	2	3	3
70-80%	-	-	-	-	-	-	-	-	4	9
80-90%	-	-	-	-	-	-	-	-	-	2
Total	15	15	15	15	15	15	15	15	15	15

6. Cost effective analysis

	Components	Cost
Standard Vac	Vac sponge, Vac Canister, Vac drape, Vac pump	159.6$ (Rs 9582/-) per dressing
Simplified Vac	Duster sponge, Chest drain, Ioban sheet, ward suction machine	12.1$ (730/-) per dressing
Conventional dressing	Sterile pads, Wipers, Betadine, Normal saline	Dressing Rs110/- per dressing , 10 dressings over 5 days i.e., Rs 1100

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

7. Patient compliance to dressing: 14 of 15 patients were compliant to simplified Vac in comparison to 10 of 15 patients for daily debridement and conventional dressing.

Discussion:
Analysis of data: This prospective randomised non-blinded study included a total number of 30 patients and compared conventional moist gauze dressing to simplified Vac dressing. Outliers were eliminated. Eligible patients are randomly assigned alternatively for either conventional moist gauze dressing or VAC dressing. The patients recruited into study aged between 48 and 63.

The mean age of conventional group is approximately 55.33 years and the Vac group is 56.93, there is no significant difference in age distribution between the two groups.

Sex distribution in both groups is also nearly identical with males constituting 60% and females 40% in conventional and VAC groups

The mean area of wound in both conventional and VAC groups is comparable (50.56 ± 6.94 vs 52.23 ± 5.12). There is no significant difference in mean area of wounds in between the groups.

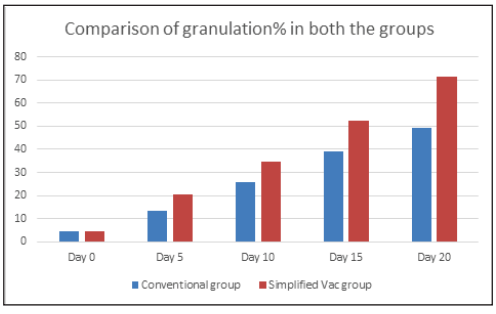
The mean percentage of granulation at day 0 of both conventional and VAC groups are comparable (4.47 ± 2.62 vs 4.67 ± 3.53) and there is no significant difference between the two groups.

The mean percentages of granulation at day 5 over the ulcer floor in conventional and VAC groups are 13.48 ± 7.42 and 20.74 ± 9.40 respectively. The mean percent granulation in the VAC group is 7.26 % higher than the conventional group which is found to be significant.

The mean percentages of granulation at day 10 over the ulcer floor in conventional and VAC groups are 25.87 ± 8.16 and 34.88 ± 10.72 respectively. There is a significant difference with mean percent of granulation at day 10 of VAC group higher by 9.01% than conventional group.

The mean percentages of granulation at day 15 over the ulcer floor in conventional and VAC groups are 38.91 ± 7.94 and 52.33 ± 9.43 respectively. The percent mean granulation at day 15 in VAC group is 13.42% higher than the conventional group which is significant. 2 patients in the VAC group had percent granulation > 60% compared to none in the conventional group which is significant.

The mean percentages of granulation at day 20 over the ulcer floor in conventional and VAC groups are 49.42 ± 10.79 and 71.6 ± 8.37 respectively. The VAC group had 22.18% higher mean granulation at day 20 compared to conventional group which is significant. 11 patients in the VAC group had percent granulations >70% compared to 4 in the conventional group which is also significant.



Joseph et al.,[26] studied negative pressure wound therapy vs conventional moist wound dressings in chronic wounds. The rate of granulation is 81.7% in NPWT group compared to 54.3% in conventional group which is comparable to the present study.

Tauro et al.,[27] studied negative pressure wound therapy vs conventional moist wound dressings in chronic wounds. The rate of granulation is 71.43% in NPWT group compared to 52.85% in conventional group which is comparable to the present study.

In our study, 33.3% reduction in cost was achieved with Vac dressing in comparison with the conventional daily twice dressing with no compromise in rate of granulation, wound contraction.

In our study, 93.33% patients were compliant to simplified Vac in comparison to 66.66 patients for daily debridement in the conventional group, because of the pain, frequency of the dressing and prolonged time taken to the dress the wound.

Advantages of Simplified Vac vs Conventional dressing
1. Ability to maintain a seal from outside environment, continuous negative pressure within recommended limits & drainage of wound exudates without any need of daily dressings or early dressings changes implies its superiority over conventional dressings.

2. Vac dressings were intact & fully functioning for 5 days before changes were required. Cost with regard to Vac, which requires changes once for every 5 days has been significantly reduced, when compared to daily twice dressing in conventional group.

3. Mean time spent on dressings over different wound was 1 to $1^{1/2}$ hours. Patients with large wounds required additional time in view to obtain complete seal with a mean placement time of 15.6 minutes/day (similar to that described on literature 5.44 minutes/day.[28]

4. Granulations are achieved quicker, thereby decreased hospital stay.

Disadvantages of Simplified Vac vs conventional dressing
1. The difficulty in maintaining the seal over the wound has been regarded as major issue.

2. Exudate leakages through edges of dressings were easily solved with application of adhesive films on streaming sites.

3. Obstructive of drain tubes from blood clots, or serous clots occurred in few cases (6.6%). This was countered by replacement of drain tubes & routine use of larger calibre drain tubes.

4. Intermittently suction device has to be switched on and off (every 30mins).

Limitations of the study
Sample size is a major limitation of the present study.The present study could not estimate accurately the rate of granulation in the wounds and factors like diabetes influence on wound healing was not studied separately as a variable.

Conclusion
Use of simplified Vac in our study led to early satisfactory results in 73.33% patients by day 20 and yields similar results as that of standardised Vac, in the most cost effective way without compromising the outcomes; further decreasing the patients hospital stay and increased patient compliance to therapy when compared to daily debridement with conventional dressings.

Conflict of interest
There are no conflict of interest statements. Neither of the authors have any financial interests, commercial associations, or other affiliations which may pose a conflict of interest to disclose. Furthermore, this paper was not supported by any external funding, nor were any special products, devices or

Volume : 6 | Issue : 12 | December : 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 79.96

drugs used in the work presented.

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